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CHINESE OCEANOGRAPHIC RESEARCH

Trends in Topical and Geographic Focus

BY PETER C. CHU AND RONGFENG LI

Since the economic boom that started in the early 1990s, China has expanded its educational and scientific programs. Funds have increased rapidly for education and scientific research. From 1993 to 2006, enrollment of full-time students in universities and colleges increased from 924,000 to 5,400,000; the total number of students (including part-time) increased from 5,000,000 to 25,000,000; and the percentage of the enrolled full-time students in the 18–22 age group jumped from 5% to 22% (Table 1). In the same time period, research funds for ocean sciences from the National Natural Science Foundation of China (NSFC) increased from 12.33 million Chinese yuan (CNY) supporting 58 projects to 40.05 million CNY supporting 141 projects. Similarly, NSFC funds for the geosciences increased from 105.31 to 351.38 CNY and the number of projects more than doubled (Figs. 1 and 2). Universities, research institutes, and laboratories have been expanded or reorganized. Small colleges have been combined and upgraded into big universities. Along with these changes, the oceanographic community has been growing rapidly and new Chinese-language journals have been created. To inform foreign ocean scientists about the Chinese oceanographic community and its priorities for future collaboration, we will introduce the research

institutes and universities where oceanography is studied and reveal trends in 38 Chinese-language oceanography journals.

RESEARCH INSTITUTES AND UNIVERSITIES. Oceanographic research in China is usually conducted in research institutes and universities (Table 2). These institutes belong to three major government divisions: 1) the State Oceanic Administration (SOA), which strongly parallels the oceanic component of NOAA; 2) the Chinese Academy of

TABLE 1. Comparison of student enrollment between 1993 and 2006.

	1993	2006
Enrollment of full time students in national/provincial universities	924,000	5.4 million
Total number of students (including part-time)	5 million	25 million
Percentage of enrolled students in the age group (18–22)	5%	22%

SOURCE: www.albertachina.com/upload/IB_BEJING-_I23071-v1-China_Higher_education

Sciences (CAS), which appears to parallel the Russian Academy of Science in that it has operational arms, institutes, ships, laboratories, etc.; and 3) the Chinese Academy of Fishery Science (CAFS), which belongs directly to the Ministry of Agriculture. All of these institutes are located in coastal cities of China.

The SOA is an administrative agency for the supervision and management of sea area uses and marine environmental protection, safeguarding national maritime rights and interests according to laws and regulations, and organizing and carrying out marine scientific and technical research (http://en.wikipedia.org/wiki/State_Oceanic_Administration). It has four research institutes: the First Institute of Oceanography (FIO), focusing on the Bohai Sea and Yellow Sea; the Second Institute of Oceanography (SIO), focusing on the East China

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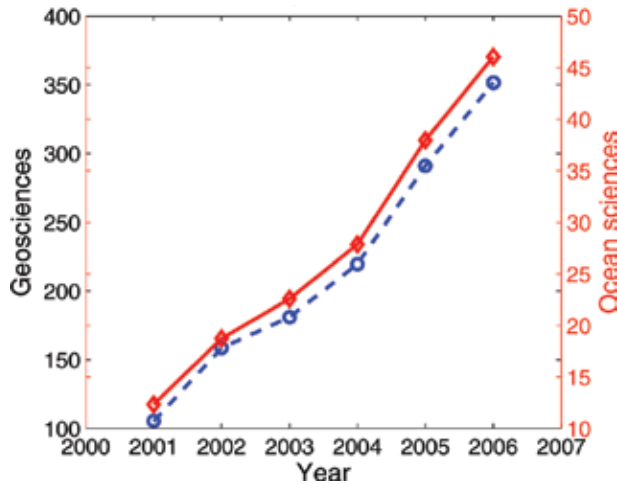


FIG. 1. Annual NSFC budget (unit: million CNY) for ocean sciences (solid) and geosciences (dashed) (from <http://www.nsfc.gov.cn/nsfc2008/index.htm>).

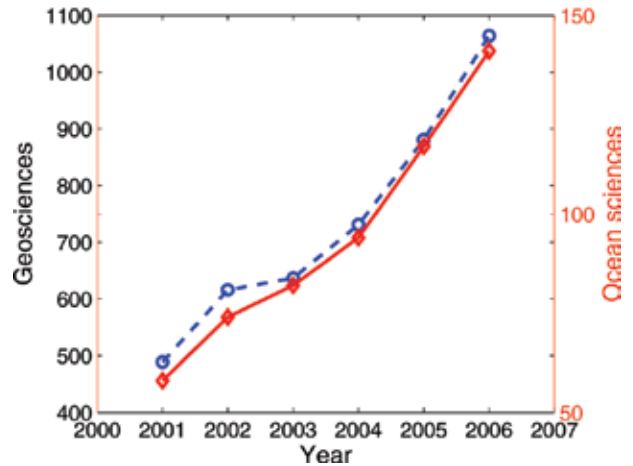


FIG. 2. Annual number of NSFC sponsored projects for ocean sciences (solid) and geosciences (dashed) (from <http://www.nsfc.gov.cn/nsfc2008/index.htm>).

TABLE 2. Major oceanographic research institutions in China.

Name	Location	Focus area	Year of est.	Web site or contact information
First Institute of Oceanography, SOA	Qingdao Shandong Province	Bohai Sea Yellow Sea	1962	www.fio.org.cn/english/index.asp
Second Institute of Oceanography, SOA	Hanzhou Zhejiang Province	East China Sea	1966	www.sio.org.cn/english/index.asp
Third Institute of Oceanography, SOA	Xiamen Fujian Province	South China Sea	1959	www.coi.gov.cn/english/eoverview/e3s/thr_jj.htm
Polar Research Institute of China, SOA	Shanghai	Arctic Antarctic	1989	www.pric.gov.cn/enindex.asp
National Marine Data and Information Service, SOA	Tianjin	Ocean data	1958	www.nmdis.gov.cn/nmdis_e.html
National Center for Marine Environment Forecast, SOA	Beijing	Prediction for all coastal seas of China		8 Dahuisi Road, Haidian District, Beijing 100081 China E-mail: wlz@nmefc.gov.cn
National Ocean Technology Center, SOA	Tianjin	Ocean engineering/technology		www.notc.gov.cn
Institute of Oceanology, CAS	Qingdao Shandong Province	Frontiers of world ocean sciences	1959	www.qdio.ac.cn/English/index.asp
South China Sea Institute of Oceanology, CAS	Guangzhou Guangdong Province	South China Sea	1959	www.scsio.ac.cn/scsio/default.htm
Chinese Academy of Fishery Science	21 institutes over China's coastal regions	Coastal Seas of China	1978	www.lib.noaa.gov/china/archi/headquarters.htm

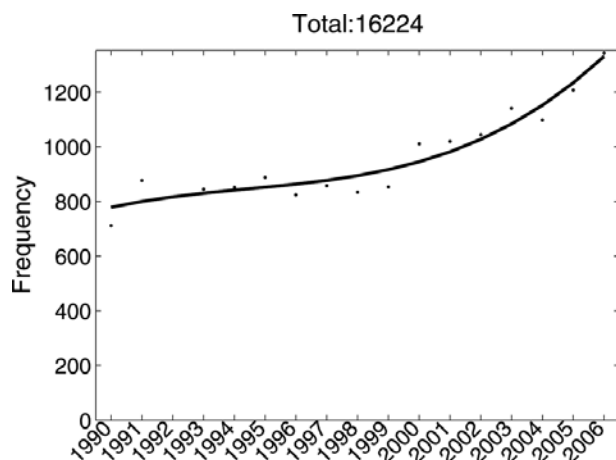


FIG. 3. Yearly (1990–2006) number of oceanographic papers published in 38 Chinese-language journals.

Sea; the Third Institute of Oceanography (TIO), focusing on the South China Sea; and the Polar Research Institute of China (PRIC), focusing on the Arctic and Antarctic. The SOA also has several research/operational centers, such as the National

Marine Data and Information Service, the National Center for Marine Environment Forecast, and the National Ocean Technology Center. The CAS has two institutes: the Institute of Oceanology, focusing on frontiers of world ocean sciences, and the South China Sea Institute of Oceanology, focusing on various processes in the South China Sea. The CAFS, headquartered in Beijing, has 21 related institutions of oceanography and fishery-related research spreading over coastal regions.

China has 11 universities offering undergraduate and graduate oceanographic curricula (Table 3). Among them, the Ocean University of China located in Qingdao is the largest, with more than 10 colleges and schools; it is especially renowned for its oceanography and fisheries programs. It is a comprehensive university with science, engineering, agronomy (fishery), medical science (pharmacology), liberal arts, philosophy, and economics. The other universities, spread out among coastal cities, have their own strengths and focus areas. Readers can find useful information about them from the Web sites listed in Tables 2 and 3.

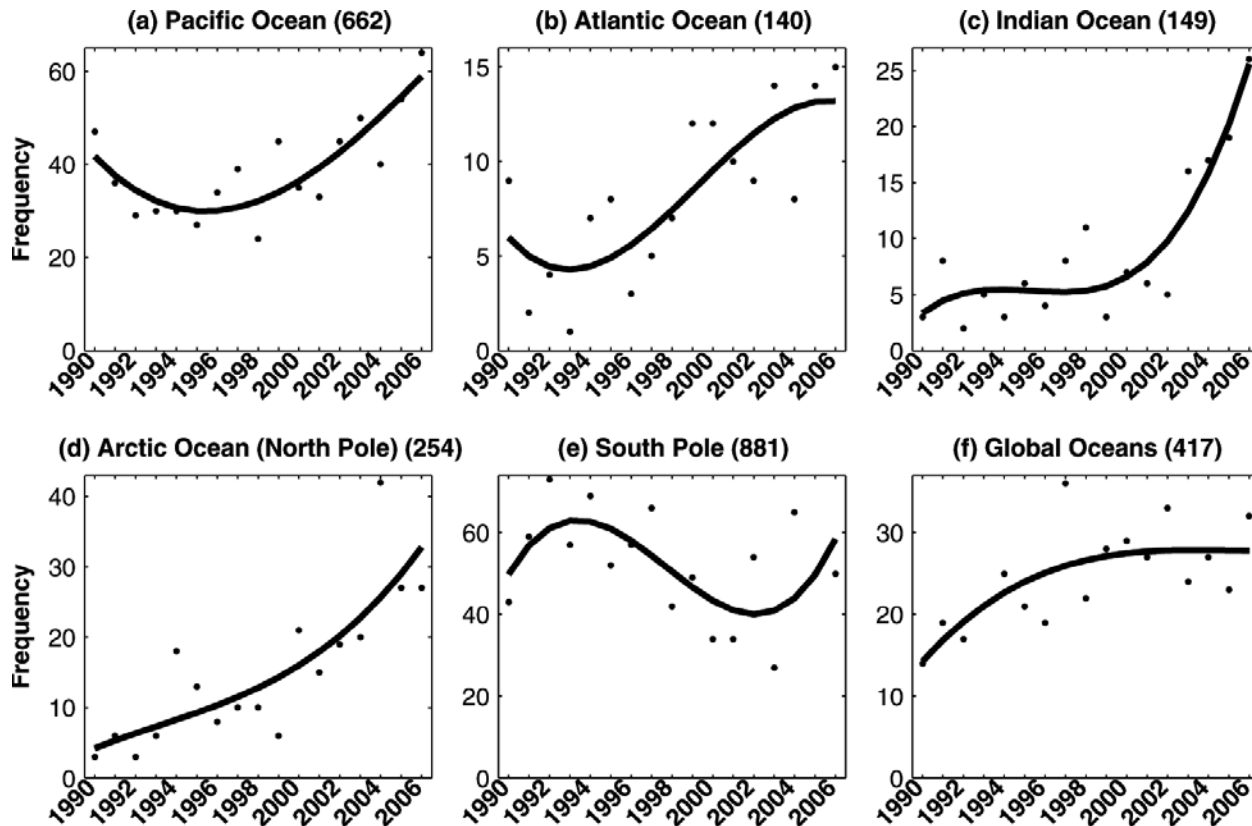


FIG. 4. Yearly (1990–2006) number of papers published for major ocean basins.

CHINESE-LANGUAGE OCEANOGRAPHIC JOURNALS. Almost all of these institutes and universities in China publish oceanographic journals in the Chinese language. Among 38 Chinese-language journals (Table 4), very few are published by professional societies:

Acta Oceanologica Sinica by the Chinese Oceanographic Society; *Oceologia et Limnologia Sinica* by the Chinese Society of Oceanography and Limnology; *Progress in Earth Sciences* and *Progress in Natural Sciences* by NSFC; and *China Sciences* and *Chinese Science Bulletin* by CAS. This is very different from the western world, especially the United States, where the oceanographic journals are all published by professional societies such as the AMS, the American Geophysical Union, the Oceanography Society, and the Marine Technological Society.

Some Chinese-language journals have an evident geographical focus, such as *East China Sea Marine Science* for the East China Sea and *Research and Development in the South China Sea* for the South China Sea. Some journals have an evident topic focus, such as *Marine Forecasts*, for prediction only.

BIBLIOGRAPHIC STUDIES. Some of these journals have relatively long histories of publication,

such as *Oceologia et Limnologia Sinica* (created in 1957), and others have relatively short histories, such as *Chinese Journal of Polar Research* (created in 1988). To investigate the development and tendencies in Chinese oceanography during the last two decades,

TABLE 3. Major universities in China offering oceanographic curriculum.

Name	Web site	Year of major reorganization and expansion
Dalian Fishery University (Liaonin Province)	www.dlfu.edu.cn	1978
Dalian Maritime University (Liaonin Province)	http://english.dlmu.edu.cn	1953
East China Normal University (Shanghai)	www.ecnu.edu.cn	1951
Guangdong Ocean University (Guangdong Province)	www.gdou.edu.cn	1997
Hainan University, Ocean College (Hainan Province)	www.hainu.edu.cn/xy_haiyang	2002
Hohai University (Nanjing)	http://en.hhu.edu.cn	1952
Nanjing University, School of Geographic and Oceanographic Sciences (Nanjing)	http://sgos.nju.edu.cn/Index.asp	2006
Ocean University of China (Shandong Province)	www.ouc.edu.cn/english	1988
Shanghai Ocean University (Shanghai)	www.shfu.edu.cn	1985
Xiamen University, College of Oceanography (Fujian Province)	http://coe.xmu.edu.cn/I/	1996
Zhejiang Ocean University (Zhejiang Province)	www.zjou.net.cn	2005

we searched for topic and geographical focus in all the papers (total: 16,224) published since 1990 in the 38 journals listed in Table 4. The purpose is to provide useful information for future collaboration between U.S. and Chinese oceanographers.

Since the Chinese journals don't have subject

TABLE 4. Chinese language journals publishing oceanographic papers.

海洋学报 (<i>Acta Oceanologica Sinica</i>), www.ilib.cn/P-hyxb.html	沉积学报 (<i>Acta Sedimentologica Sinica</i>), www.ilib.cn/P-cjxb.html
地球科学进展 (<i>Advances in Earth Sciences</i>) www.ilib.cn/P-dqkxjz.html	海洋科学进展 (<i>Advances in Marine Science</i>) www.ilib.cn/P-hbhh.html
中国科学 (<i>China Sciences</i>) (D) www.scichina.com/new_web_Fa/index.asp	大气科学 (<i>Chinese Journal of Atmospheric Sciences</i>) www.ilib.cn/P-daikx.html
地球物理学报 (<i>Chinese Journal of Geophysics</i>) www.geophy.cn/cn/dqml.asp	极地研究 (<i>Chinese Journal of Polar Research</i>) www.lunwentianxia.com/qikan_detail_314
科学通报 (<i>Chinese Science Bulletin</i>) www.ilib.cn/P-kxtb.html	海岸工程 (<i>Coastal Engineering</i>) www.cqvip.com/qk/95947X/200004/index.shtml
海洋学研究 (<i>East China Sea Marine Science</i>) www.cqvip.com/qk/96340X/199301/	海洋测绘 (<i>Hydrographic Surveying and Charting</i>) www.ilib.cn/P-hych.html
大连水产学院学报 (<i>Journal of Dalian Fishery University</i>) www.ilib.cn/P-dlscxyxb.html	华东师范大学学报(自然科学版) [<i>Journal of East China Normal University (Natural Sciences)</i>], www.cqvip.com/qk/90014X
水产学报 (<i>Journal of Fisheries of China</i>) www.ilib.cn/P-scxzb.html	湛江海洋大学学报 (<i>Journal of Guangdong Ocean University</i>) www.cqvip.com/qk/93246A/200604
河海大学学报 (<i>Journal of Hohai University</i>) www.ilib.cn/P-hhdxxb.html	水动力研究与进展 (<i>Journal of Hydrodynamics</i>) http://scholar.ilib.cn/Periodical.aspx?P=sdlxyjyz
中国海洋大学学报 (<i>Journal of Ocean University of China</i>) www.cqvip.com/qk/92605A/200601/index.shtml	台湾海峡 (<i>Journal of Oceanography in Taiwan Strait</i>) www.cqvip.com/qk/90949X/index.shtml
上海水产大学学报 (<i>Journal of Shanghai Fishery University</i>) www.ilib.cn/P-shscdxxb.html	热带海洋学报 (<i>Journal of Tropical Oceanography</i>) www.ilib.cn/P-rdhy.html
厦门大学学报 (<i>Journal of Xiamen University</i>) www.ilib.cn/P-xmdxxb.html	浙江海洋学院学报 (<i>Journal of Zhe-Jian Ocean University</i>) http://dx2.cqvip.com/qk/97875A/200604
海洋预报 (<i>Marine Forecasts</i>) www.ilib.cn/P-hyyb.html	海洋地质 (<i>Marine Geology</i>) www.cqvip.com/qk/98440X/200603/index.shtml
海洋通报 (<i>Marine Science Bulletin</i>) www.ilib.cn/P-hytb.html	海洋与海岸带开发 (<i>Ocean Development and Management</i>) www.ilib.cn/I-hykfygl.2002.04.html
海洋工程 (<i>Ocean Engineering</i>), www.ilib.cn/P-hygc.html	海洋科学 (<i>Ocean Sciences</i>), www.ilib.cn/P-hykb.html
海洋科学消息 (<i>Ocean Science News</i>) www.cqvip.com/qk/97093X/199104/index.shtml	海洋世界 (<i>Ocean World</i>) www.cqvip.com/qk/91227X/index.shtml
海洋技术 (<i>Ocean Technology</i>) www.ilib.cn/P-hyjs.html	海洋与湖沼 (<i>Oceologia et Limnologia Sinica</i>) www.cqvip.com/qk/90072X
地球物理学进展 (<i>Progress in Geophysics</i>) http://dqwj.chinajournal.net.cn	自然科学进展 (<i>Progress in Natural Sciences</i>) http://zrkxjz.nt.nf2us.com/index.html
南海研究与开发 (<i>Research and Development in the South China Sea</i>) www.cqvip.com/qk/94902X/199403/index.shtml	海洋湖沼通报 (<i>Transaction of Oceanology and Limnology</i>) www.ilib.cn/P-hyhzbt.html

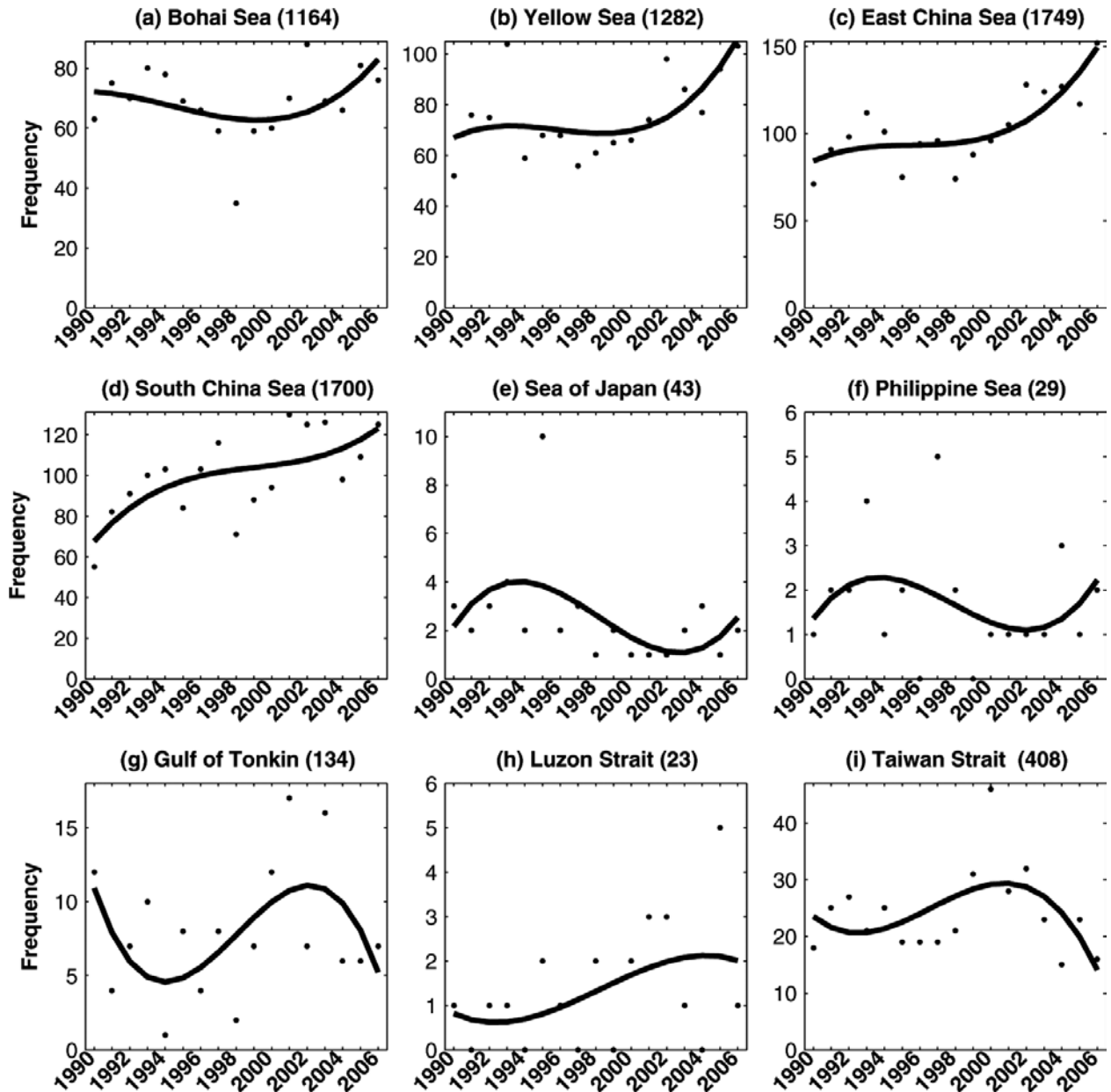


FIG. 5. Yearly (1990–2006) number of papers published for the East Asian regional seas.

indices at the end of a year, a bibliographic study is tedious, requiring each paper to be read. The number of published papers is quite steady from 1990 to 1999, with around 820 papers per year, and afterward increases to 1,343 papers in 2006 (Fig. 3). During the bibliographic study, we classified articles by 34 geographical focus areas (e.g., Bohai Sea, East China Sea, South China Sea, Yellow Sea, Indian Ocean, western Pacific) and 180 topics (e.g., acoustic detection, current system, numerical simulation,

ocean environment). Some papers had more than one topic focus.

GEOGRAPHICAL FOCUS AREAS. Table 5 lists the focus areas with an associated number of published papers (n) during 1990–2006. It is not surprising that the Chinese coastal seas are the most common geographical focus, with the East China Sea the focus of 1,749 papers, followed by the South China Sea, the Yellow Sea, and the Bohai Sea. Figure 4 shows

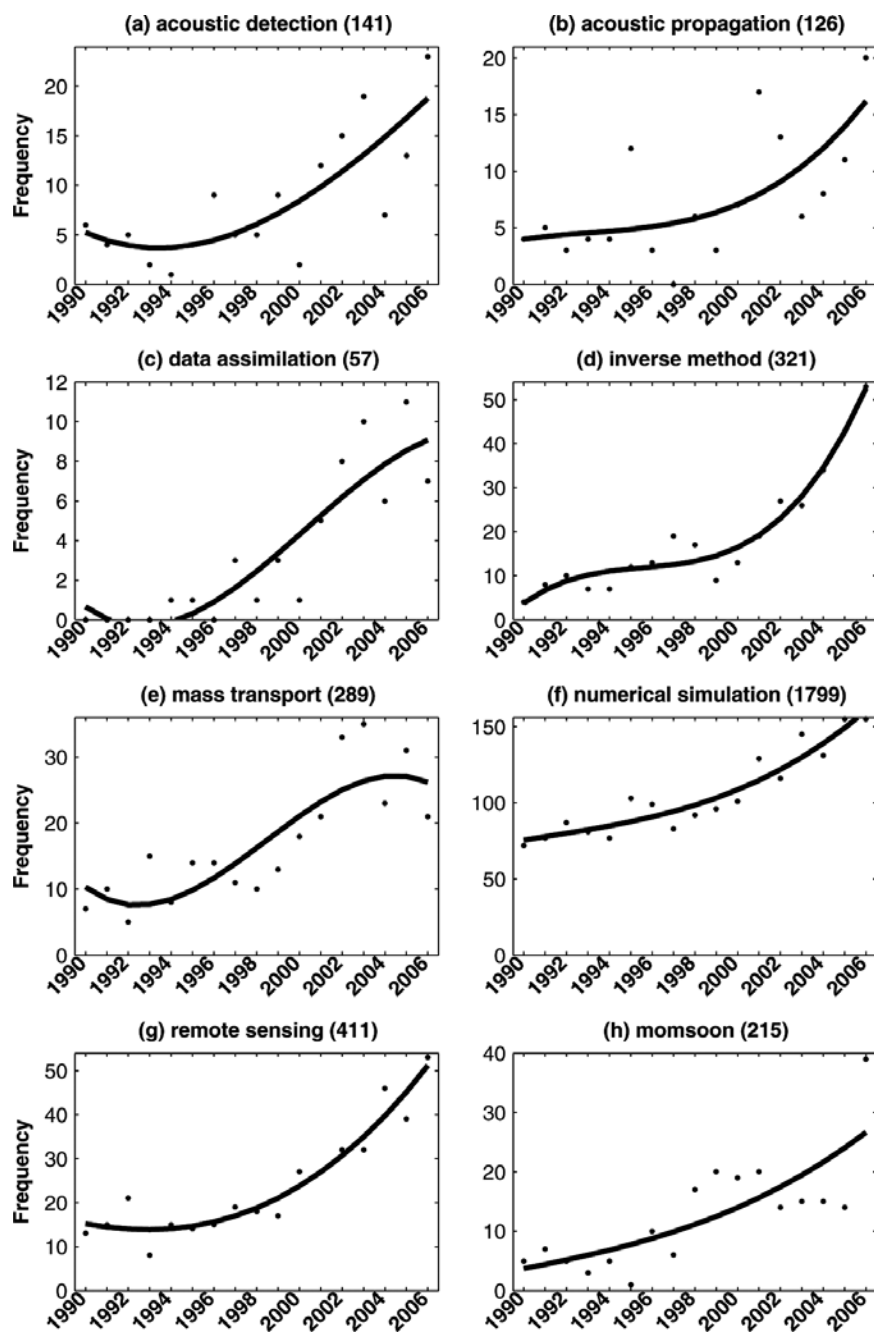


FIG. 6. Yearly (1990–2006) number of papers published for various topics with upward trends.

the yearly number of papers published for the Pacific Ocean, Atlantic Ocean, Indian Ocean, Arctic Ocean, South Ocean/Antarctic, and global ocean. For the whole period (1990–2006), two areas (Indian Ocean and Arctic Ocean) have very evident upward trends. Indian Ocean papers increased from 3 in 1990 to 26 in 2006, and the Arctic Ocean from 3 in 1990 to 27 in

2005 and 2006. For the recent years (1999–2006), two focus areas (Pacific and Atlantic) had upward trends: with the Pacific Ocean (from 24 papers in 1998 to 64 papers in 2006), and the Atlantic Ocean (from 1 paper in 1993 to 15 papers in 2006). For the global ocean, a maximum number of papers (36) were published in 1997. Disregarding this spike, we still found a weak upward trend from 14 papers in 1990 to 32 papers in 2006.

Figure 5 shows the yearly number of papers published for various coastal regions near China. For the whole period (1990–2006), two areas (East China Sea and Luzon Strait) have evident upward trends, with the East China Sea being the most significant in going from 71 papers in 1990 to 152 papers in 2006. In the past decade (1997–2006), two areas (Bohai Sea and Yellow Sea) have yielded increased publications. This is possibly due to the fast economic growth in the coastal areas, which makes coastal oceanography of the China Seas a high priority.

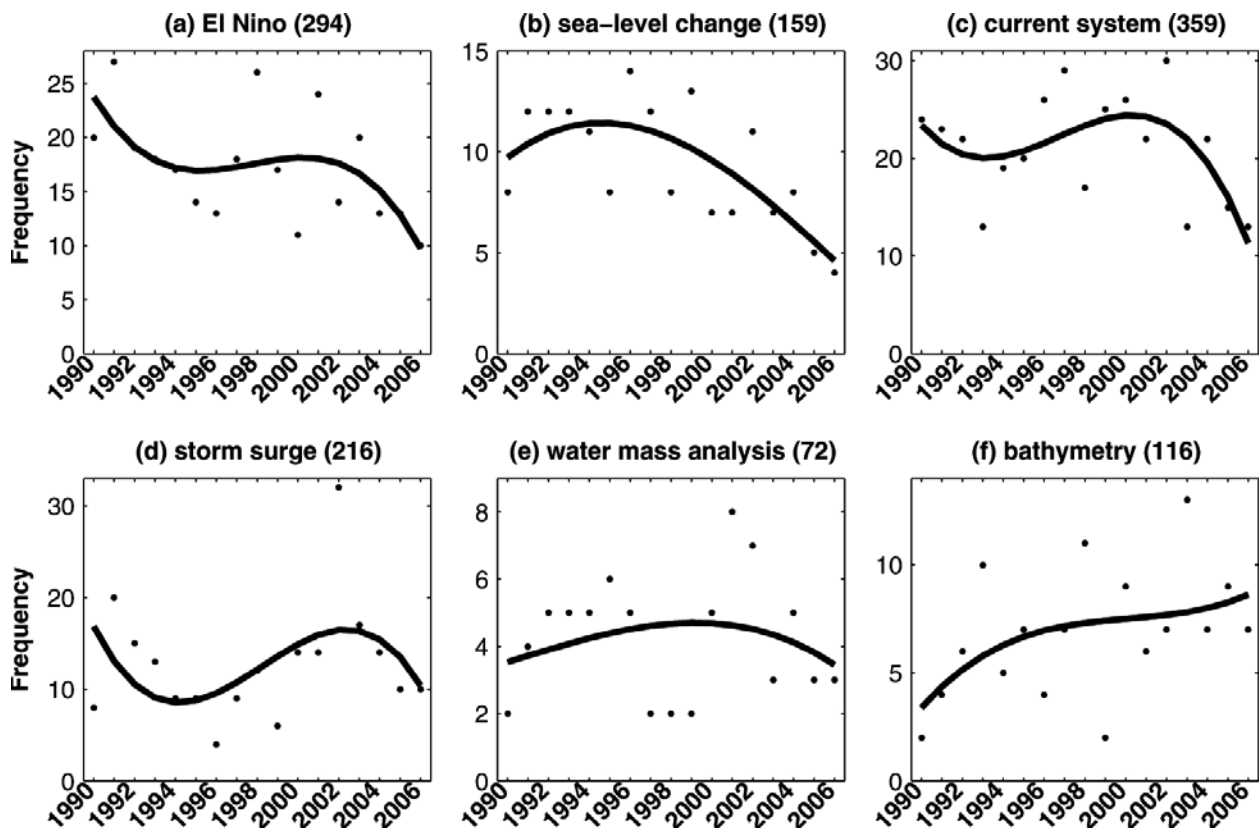
TOPICAL FOCUS. Figure 6 shows the yearly (1990–2006) number of papers published for some topical areas with an evident upward trend. Comparing 3-year periods—say, the 1990–92

total to the 2004–06 total—“acoustic detection” increases as a primary topic from 15 to 43 papers; “data assimilation” from 0 to 24 papers; “inverse method” from 22 to 130 papers; and “numerical simulation” from 236 to 441 papers. However, some priorities have diminished in recent years (Fig. 7), with “El Niño” declining from 26 papers in 1998 to 10 in

TABLE 5. Number of papers published for various focus areas (1990–2006).

Focus area	# of papers	Focus area	# of papers
East China Sea	1749	Atlantic Ocean	140
South China Sea	1700	Gulf of Tonkin	134
Yellow Sea	1282	Gulf of Day	120
Bohai Sea	1164	Paracel Islands	56
Antarctic	881	Sea of Japan	43
Pacific Ocean	662	Philippine Sea	29
Yangtze River Delta/Estuarine	434	Luzon Strait	23
Global Oceans	417	Mariana Trench	23
Taiwan Strait	408	Pratas Islands	14
Western Pacific	296	Sea of Okhotsk	6
Yellow River Delta/Estuarine	278	Huai River Delta/Estuarine	3
Arctic	254	Gulf of Thailand	2
Pearl River Delta/Estuarine	239	Tsushima/Korean Strait	1
Spratly Islands	219	Strait of Malacca	1
Indian Ocean	149	Guan	1
Okinawa	141		

FIG. 7. Yearly (1990–2006) number of papers published for various topics with no evident trends.



2006; “sea-level change” from 14 papers in 1996 to 4 in 2006; “current system” from 30 papers in 2002 to 13 in 2006; and “storm surge” from 32 papers in 2002 to 10 in 2006.

This database is available through the website (http://faculty.nps.edu/ccchu/chinese_oce_files/index.htm) of the Naval Ocean Analysis and Prediction Laboratory at the Naval Postgraduate School. This bibliographic study points out the priorities and focus areas of the Chinese oceanic

research, and we hope it inspires collaboration between the United States’ and China’s oceanic research communities.

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PAPERS OF NOTE

WHAT’S THE TRUE VALUE OF FORECASTS?

Understanding the economic value of weather and climate forecasts is of tremendous practical importance. Forecast valuation is necessary if we are to gauge when a forecast product can be favorably applied to a given decision problem, and it also plays an important role in legitimizing meteorological research in wider society. The research described here compares measures of forecast value based on two different assumptions about users’ decision-making behavior. Results reveal that behavior can be as important as forecast skill in determining the value that users realize from forecasts.

Traditional approaches to forecast valuation can be broken into two camps: prescriptive studies (what forecasts should be worth to the idealized hyper-rational agents of standard economic theory), and descriptive studies (what forecasts are worth to real, fallible human beings in complex decision contexts). The former approach employs mathematical models of optimal decision behavior to derive normative measures of the value of forecasts, while the latter usually involves detailed empirical investigations of fore-

cast users’ behavior in the field. Both methodologies have their pros and cons. Prescriptive studies yield clean theoretical results that are easily interpreted, but their assumptions about human decision behavior are unrealistic in many cases. While they provide a benchmark against which reality can be compared, they cannot give any insight into how real users might deviate from this ideal, and are thus of little use when it comes to targeting attempts to increase the value that users realize. In contrast, descriptive studies do resolve the effects of nonoptimal user behavior on forecast value, but their use has proven difficult when trying to generate causative hypotheses that quantify how specific behavioral effects might interact with other parameters of the decision environment in determining deviations from the normative ideal.

In this new study, a model of forecast value is proposed that attempts to bridge the gap between these two approaches and address some of their weaknesses. The model relaxes some of the assumptions about user decision behavior that the normative framework employs to assess forecast value. In particular, users are no longer

assumed to possess a perfect a priori statistical understanding of the forecast products they use. Rather, they make sequential choices between using the forecasts and relying on climatology. Over time they learn from the consequences of these choices in a manner consistent with a prominent psychological theory of learning behavior known as reinforcement learning. This theory is applied to a simple decision problem—the cost-loss

ECHOES

“ You know something?
It’s hard to come back.”

—CRAIG STREHLOW, Fargo, North Dakota, resident on the record-breaking spring floods in eastern North Dakota’s Cass County. The floods caused millions of dollars in damage in March and April after snow, ice, and heavy rain pushed rivers and streams out of their banks and forced evacuations. The total cost of damaged homes hasn’t been assessed, but nearly 800 claims have been paid out for repairs totaling \$8.6 million by a Federal Emergency Management Agency program. Many homeowners were still waiting to hear if the federal government would buy out their properties. (SOURCE: The Associated Press)